DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

3. Claims 17, 20, 21, 23, 24 and 26-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevens (US 2002/0155329) in view of Monzyk et al. (US 6,503,298).

Regarding claim 17, Stevens discloses a method for generating a hydrogen-rich reformate (see abstract), the method comprising the steps of:

reacting a hydrocarbon fuel in a catalyst bed (41, 42) comprising a reforming catalyst and carbon dioxide fixing material (paragraph 0007, lines 1-6) to produce a reformate comprising hydrogen and carbon dioxide, the carbon dioxide fixing material fixing at least a portion of the carbon dioxide in the reformate to produce an intermediate reformate (paragraph 7, lines 10-12).

While Stevens discloses a hydrogen generation process from a reforming unit for use in a fuel cell, Stevens fails to explicitly disclose the steps of:

-removing hydrogen from the intermediate reformate by flowing the intermediate reformate through a first purification bed comprising an inert material having a high heat capacity and a hydrogen fixing material to produce a hydrogen-depleted gas and fixed hydrogen; and

releasing the fixed hydrogen from the first purification bed to produce a hydrogen-rich gas;

the hydrogen fixing material comprises a metal hydride;

-claim 21- removing heat from the first purification bed;

-claim 23 - interrupting flow of a feed gas;

-claim 24 – purging the first purification bed to remove hydrogen-depleted gas prior to releasing the fixed hydrogen;

-claim 26 – the fixed hydrogen is released from the first purification bed by imposing a change in temperature on the hydrogen fixing material;

-claim 27 – diverting the feed from the first purification bed and flowing the feed through a second purification bed;

-claim 28 – wherein the fixed hydrogen is released from the first purification bed while the feed flows through the second purification bed;

-claim 29 – wherein fixed hydrogen is released from the first purification bed by heating the hydrogen fixing material within the first purification bed with heat derived in part from the second purification bed, and

-claim 30 – releasing fixed hydrogen from the second purification bed by imposing a change in temperature on the hydrogen fixing bed.

Monzyk discloses a preferable hydrogen purification unit that can be used downstream of a reformer (as used in Stevens) and used to produce hydrogen for a fuel cell (col. 18 lines 11-24).

Monzyk teaches a method of purifying hydrogen for a fuel cell comprising the steps:

-removing hydrogen from the intermediate reformate by flowing the intermediate reformate through a first purification bed (sorption state, Fig. 11) comprising an inert material having a high heat capacity (such as a porous substrate, col. 12 lines 48-52) and a hydrogen fixing material (metal hydride, see claim 23 of Monzyk) to produce a hydrogen-depleted gas and fixed hydrogen (col. 2 lines 32-42); and

-releasing the fixed hydrogen from the first purification bed to produce a hydrogen-rich gas (col. 2 lines 52-55) and the hydrogen fixing material comprises a metal hydride (see claim 23 of Monzyk).

-claim 21- removing heat from the first purification bed (thermal swing sorption, col. 5 lines 26-31, see cool water stream in Fig. 11).

-claim 23 - interrupting flow of a feed gas (feed switching during temperature swing cycles, col. 19 line 66 – col. 20 line 3).

-claim 24 – purging the first purification bed to remove hydrogen-depleted gas prior to releasing the fixed hydrogen (see purge step in Fig. 9a).

-claim 26 – the fixed hydrogen is released from the first purification bed by imposing a change in temperature on the hydrogen fixing material (col. 2 lines 52-55).

-claim 27 – diverting the feed from the first purification bed (sorption state, see Fig. 11) and flowing the feed through a second purification bed (desorption state, see Fig. 11, this is part of the thermal swing process described by Monzyk, col. 2 lines 32-65, col. 19 line 66 – col. 20 line 3).

-claim 28 – wherein the fixed hydrogen is released from the first purification bed while the feed flows through the second purification bed (see desorption and sorption steps of Fig. 11, col. 2 lines 32-65, col. 19 line 66 – col. 20 line 3).

-claim 29 – wherein fixed hydrogen is released from the first purification bed by heating the hydrogen fixing material within the first purification bed with heat derived in part from the second purification bed (col. 17 lines 38-45, Fig. 8).

-claim 30 – releasing fixed hydrogen from the second purification bed by imposing a change in temperature (heatup) on the hydrogen fixing bed (thermal swing cycle, as described above, col. 2 lines 32-65, col. 19 line 66 – col. 20 line 3).

Monzyk teaches this process as an efficient and preferable way of purifying hydrogen (col. 21 lines 17-24). Furthermore, Stevens discloses the preference for high purity hydrogen for the efficient operation of a fuel cell and lower cost (see paragraph [0006] of Stevens). As such, it would have been obvious to one of ordinary skill in the art at the time of the invention to add the hydrogen purification process of Monzyk to the hydrogen generating process of Stevens in order to provide high purity hydrogen in an efficient way for uses such as in fuel cells.

Regarding claim 20, Stevens, as discussed in claim 17 above, further discloses a water gas shift catalyst contained in the catalyst bed (paragraph [0026] lines 11-19).

4. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Stevens (US 2002/0155329) in view of Monzyk et al. (US 6,503,298), as applied to claim 17 above, and further in view of Golben (US 5,250,368).

Regarding claim 18, modified Stevens, as discussed in claim 17 above, teaches the use of metal hydrides to adsorb/store hydrogen in the first purification bed, but fails to teach removal of water from the reformate stream prior to entry into the first purification bed.

Golben also teaches a metal hydride employed to store/adsorb hydrogen (see abstract).

Golben teaches that water is preferably removed from the hydrogen stream (20) prior to entry into the metal hydride storage vessel (50) as water is damaging to metal hydride and can decrease the adsorbing efficiency of the metal hydride (col. 5 lines 59-67 and col. 6 lines 5-15).

It would have been obvious to one of ordinary skill in the art at the time of the invention to add the water removal step of Golben, into the hydrogen generating process of modified Stevens prior to the purification bed (which comprises metal hydride) in order to prevent the destruction of the metal hydride and the reduction in adsorbing efficiency of the metal hydride.

5. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Stevens (US 2002/0155329) in view of Monzyk et al. (US 6,503,298), as applied to claim 17 above, and further evidenced by Heung (US 5,958,098).

Regarding claim 19, modified Stevens, as discussed in claim 17 above, further discloses a methanation step (44, paragraph [0034]). Moreover, it would have been obvious to place the methanation step of the modified Stevens prior to the first purification bed in order to remove carbon monoxide which is known in the art to be a poison to metal hydrides (see Heung, col. 1 lines 34-38).

6. Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Stevens (US 2002/0155329) in view of Monzyk et al. (US 6,503,298), as applied to claim 17 above, and further evidenced by Schiodt et al. (US 2001/0055560).

Regarding claim 22, Stevens, as discussed in claim 17, fails to disclose the step of monitoring the hydrogen-depleted gas.

Schiodt also teaches a method for producing hydrogen rich gas (see title).

Schiodt teaches a chromatograph that continuously monitors the effluent from a hydrogen producing reactor as a way to monitor the effect of the catalyst, as in determining when it is becoming deactivated (paragraph [0037]).

It would have been obvious to one of ordinary skill in the art at the time of the invention to add the composition monitoring step of Schiodt to the hydrogen generation process of modified Stevens in order to monitor the performance of the catalyst to determine when deactivation takes place.

Response to Arguments

7. Applicant's arguments filed 10/27/2010 have been fully considered but they are not persuasive.

On page 9, Applicant argues that Stevens, as modified by Monzyk fails to teach "an inert material having a high heat capacity". The examiner respectfully disagrees with this argument. Monzyk, explicitly teaches a porous support material for the sorbent which does not participate in any chemical reaction in the process. Furthermore, the support comprises a certain heat capacity. A "high" heat capacity is a relative term and no reference point is given in the claim, therefore, any material can qualify as having a "high" heat capacity.

Conclusion

8. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MATTHEW J. MERKLING whose telephone number is (571)272-9813. The examiner can normally be reached on M-F 8:30-4:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alexa Neckel can be reached on (571) 272-1446. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/M. J. M./
Examiner, Art Unit 1723

/Alexa D. Neckel/
Supervisory Patent Examiner, Art Unit 1723